

In-Use Emissions Testing with Portable Emissions Measurement Systems (PEMS) in the Current and Future European Vehicle Emissions Legislation: Overview, Underlying Principles and Expected Benefits

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ABSTRACT

In-use testing with Portable Emissions Measurement Systems (PEMS) has received attention by policy makers and industry as an effective and cost-efficient means to verify emissions of a wide range of vehicles. We provide an overview of the state-of-the-art PEMS in-use emissions testing in the current and future European emissions legislation for light-duty and heavy-duty vehicles as well as non-road mobile machinery.

For obtaining type approval in European Union (EU), light-duty vehicles have to comply with Euro 6 emission standards from January 2014 onward. In parallel, a new test procedure will complement standard emissions testing in the laboratory to control gaseous and particulate emissions over a wide range of real-world driving conditions. Two candidate procedures are developed at present, i.e., random cycle testing and on-road emissions testing with PEMS. Currently, key challenges are the definition of test conditions and design of a suitable method for data evaluation.

For heavy-duty vehicles, in-use testing with PEMS is already enforced in the European Union since 2009. The revision of European requirements will be completed in 2014 and shifts the focus from engine conformity checking towards the assessment of emissions under real-world driving conditions. The feasibility of PEMS for measuring particle mass is currently investigated by an industry-run pilot program. Moreover, the application of PEMS to Stage IV and V engines of non-road mobile machinery is currently under discussion.

We conclude that in-use testing with PEMS will play an important role in the future European vehicle emissions legislation. The application of PEMS can effectively control vehicle emissions, may accelerate the adoption of novel emission abatement technologies and thereby contribute to air quality improvements throughout Europe.

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2. INTRODUCTION

Transport is the backbone of the European Union's economy, accounting in 2010 for 5% of each, the gross domestic product and the total employment [1]. In 2011, European private households spent roughly 13% of their total consumption on transport-related items (replacing old vehicles, expenditures for transport services and equipment), while 83% of total passenger transport activities were covered by road transport including passenger cars, buses, trolley-buses and coaches. Road and intra-European Union maritime transport represented the most used means for goods transport covering shares up to 45% and 37% of the total freight transport

respectively [1]. However, oil dependency and environmental pollution represent two of the major challenges that European transport sector faces today.

European transport relies strongly on fossil fuels causing thereby substantial greenhouse gases (GHG) emissions. In 2011, transport consumed 364 Mtoe (21.5% of the gross inland consumption) of which only 4.6% was attributed to biofuels [1]. Transport thereby accounted for 24% of the energy-related GHG emissions of the European Union. In more detail, among all forms of transport, road transport of passengers and goods accounts for the largest share, i.e., 72% of both transport-related energy use and GHG emissions [1] and represents the most important anthropogenic source of nitrogen oxides (NO_x).